MEMORANDUM

TO: SIP Inventory Preparers and EPA Regions

FROM: Inventory Guidance and Evaluation Section
INFO: (919) 541-2825
DATE: February 5, 1992

SUBJECT: VOC Emissions from Breweries

This technical memorandum was prepared by Radian Corporation under contract to the Office of Air Quality Planning and Standards, US Environmental Protection Agency (EPA Contract No. 68-D0-0125). The objective of this work assignment is to provide technical consulting to state and local agencies preparing 1990 base year SIP emission inventories. At this time, many of the methods and emission factors for source categories in AP-42 are being revised by EPA. The interim procedures outlined in this memorandum may not conform to future releases of EPA procedures and guidance. The calculations found in this technical memorandum may be low due to the test procedures used, however, they are based on the best data available at this time.

Several states have requested additional guidance in calculating emissions from breweries. This memorandum describes two methods for calculating emissions from breweries based on a 1983 report (Rapoport, R.D., Guttman, M.A., and Rogozen, M.B., "Characterization of Fermentation Emissions From California Breweries", prepared for State of California Air Resources Board, Sacramento, CA).

The minimum amount of information necessary using the first method is the production per year. More detailed information about these sources can be used to determine a more precise emission estimate. As with any other source, seasonal adjustments should be addressed. If the brewery's annual production is not evenly distributed through the year, the emissions per day should be adjusted to account for the estimated throughput.

1. Using the brewery's production, you can determine whether it is a large or small brewery. A large brewery is one that produces 60,000 barrels or more per year, and a small brewery, less than 60,000 barrels. One barrel is 31 gallons.

Emission factors based simply on size are:

Brewery Size	Emission Factor (VOCs)

Small (< 60,000 barrels)	56.8 lbs/1000 barrels
Large (> 60,000 barrels)	4.17 lbs/1000 barrels

2. Large breweries account for most of the emissions, but small breweries have higher emissions per unit of beer, because of differences in brewing processes.

Within the large and small categories as well, there are differences in processes, and if known, can be used to calculate a more accurate emission number.

Tables 1 and 2 (from Rapoport et. al., 1983) break out emission factors for the major processes in small and large breweries. Note that the fermentation room emissions make up the major share (91%) of the small breweries' emissions. Large breweries, on the other hand, emit the larger proportion (39%) of their emissions from the brew kettle. Only 16% of the large brewery emissions come from a source comparable to the small breweries' fermentation room emissions, the activated carbon regeneration vent. The role of activated carbon will be discussed in the next paragraph.

The more detailed emission factors can be used when information about the processes are available, and in particular, if emission-control devices are in place. For instance, the emission factor for the activated carbon regeneration vent in Table 2 is for the emissions from such a device. An activated carbon scrubber removes the VOCs from the CO2 produced by fermentation. The clean CO2 is used later in the brewing process, and the VOCs are released by the activated carbon regeneration process. No control efficiency factors are available for this type of scrubber, and it is assumed that all VOCs captured by the activated charcoal are released during the regeneration process. However, the water scrubber component of the CO2 scrubber also collects VOCs, and the waste water from this device was not measured. No other process emission factors were calculated for processes using control devices. If other control devices are known to have been installed, their efficiency factors will have to be used to correct the emissions factor for that process.

Table 1
EMISSION FACTOR CALCULATIONS FOR SMALL BREWERIES[a]

	Process Site					
Parameter	Mash Tun Stack	Lauter Tun Stack	Brew Kettle Stack	Hot Wort Tank Vent	Fermentation Room Exhaust Vent	Spent Grain Holding Tank
VOC Concentration in the Sample, mg/m^3	104.71	29.50	173.78	299.05	211.53	5.10
Exhaust Flow Rate, m^3/min	1.08±.35	1.98±.57	10.50±2.04	2.90±1.00	22.12±2.45	>25.33
Process Cycle Time, min	155	145	90	40	1440	20
Amount of Beer per Cycle, bbls	96	96	96	96	288	96
Emission Factor, kg VOC/10^3 bbl	.183±.059	.088±.025	1.711±.332	.361±.125	23.395±2.591	>.027
(lb VOC/10^3 bbls)	(.403±.130)	(.194±.056)	(3.771±.733)	(.797±.275)	(51.578±5.713)	(>.060)

bbls = barrels of beer (31 gallons/barrel)

[a] Uncertainty ranges based on 95-percent confidence interval for exhaust flow rate measurements.

From: Rapoport, et. al., 1983

Table 2

EMISSION FACTOR CALCULATIONS FOR LARGE BREWERIES

	Process Site					
Parameter	Mash Cooker Stack	Rice Cooker Stack	Strainmaster Stack	Brew Kettle Stack	Activated Carbon Regeneration Vent	Beechwood Chip Washer Vent
VOC Concentration in the Sample, mg/m^3	6.19±0.76	0.28	96.59	49.26	467.72	25.37
Exhaust Flow Rate, m^3/min	134.20	141.39	94.82	133.78	10.76	98.45
Process Cycle Time, min	120	45	25	90	NA	60
Amount of Beer Per Cycle, bbls	800	800	800	800	5600	343
Emission Factor kg VOC/10^3 bbl	0.125±0.015	0.002	0.286	0.741	0.300	0.437
(lbs VOC/10^3 bbls)	(0.275±0.034)	(0.005)	(0.631)	(1.634)	(0.660)	(0.963)

NA - not applicable

From: Rapoport, et. al., 1983